

### **REMARKS**

By way of this communication applicants have canceled claims 3, 4, 5, 15, 16, 19, 20, and 21 because they read on catalytic metals other than nickel. There were two claims numbered 19, the second of which has now been canceled. Applicants have limited their catalytic metal to nickel, which is supported by the data hereof. Applicants have also added new claims 27, 28, and 29 to cover a nickel woven mesh as the nickel catalyst of choice. Support for this can be found in paragraph 0024 and in Table 8 of the instant application.

### **Rejection Under 35 U.S.C. 102(b) and in Alternative 103(a).**

Claims 1-5, 9-11, and 15-17 have been rejected under 35 U.S.C. 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as being obvious over Rosenblatt et al.

#### **Examiner's Position**

It is the Examiner's position that Rosenblatt et al. disclose a method for converting ammonia into nitrogen and hydrogen, by passing a mixture of gaseous ammonia and an oxygen-containing gas over a supported catalyst to combust the catalyst at a temperature of at least 500°C, then over a supported catalyst to crack at least some of the remaining ammonia, utilizing the heat of the combustion reaction to supply at least part of the heat required for the cracking reaction. The Examiner mentions that Rosenblatt et al. also teaches a catalyst that can constitute ruthenium that may be supported on a support, such as alumina.

#### **Applicants' Position**

The claims, as now amended, require that the catalytic metal consists essentially of nickel. Rosenblatt et al. do not teach nickel as an acceptable catalytic metal for their invention, they require that a catalytic metal must be one selected from ruthenium, rhodium, and iridium. One of the preferred embodiments of Rosenblatt et al. is to use a platinum catalyst in a first combustion stage followed by the ruthenium, rhodium, or iridium catalyst.

Also, applicants contend that one having ordinary skill in the art would not be led to the use of a nickel catalyst alone for maintaining an autothermal reaction with ammonia. There is no suggestion in Rosenblatt et al. that any catalyst system without the use of ruthenium, rhodium, or iridium can be used for the decomposition of ammonia to hydrogen and nitrogen.

Therefore, applicants request that the Examiner reconsider and withdraw this rejection.

### **Rejection Under 35 U.S.C. 103(a)**

Claims 9-11 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Rosenblatt et al..

### **Examiner's Position**

The Examiner contends that it would have been prima facie obvious to employ an alumina support in the form of a monolith as the support in the process of Rosenblatt et al. since it is well known that monoliths are employed as catalyst supports in order to provide more surface area for the catalyst to contact the reactants. With regard to claim 11 the Examiner believes that it would have been prima facie obvious to have carried out the process of Rosenblatt et al. in a thermal integration reactor wherein a hot effluent gas is produced which transfers heat to incoming feed of ammonia and an oxygen-containing gas, since Rosenblatt et al. suggest that the combustion of ammonia is exothermic whereas the decomposition of ammonia is endothermic, and one having ordinary skill in the art would be motivated not to waste the exothermic heat of reaction of the combustion step.

### **Applicants' Position**

It is applicants' position that the instant claims, as now amended, define a patentable invention over Rosenblatt et al. since Rosenblatt et al. do not suggest nor teach the use of a nickel catalyst alone for the autothermal (both exothermic and endothermic reactions) production of nitrogen and hydrogen from ammonia wherein both combustion and decomposition occur over a single catalyst. Applicants also contend that since it would not have obvious to use nickel as the

single catalytic metal for both reactions it would not have obvious to use only nickel in a thermal integration reactor.

Therefore, applicants request that the Examiner reconsider and also withdraw this rejection.

**Rejection of Claims 12-27 under 35 U.S.C. 103(a).**

Claims 12-27 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Boffito et al. in view of Rosenblatt et al.

**Examiner's Position**

It is the Examiner's position that Boffito et al. disclose a process for cracking ammonia to product hydrogen wherein the hydrogen is employed to power hydrogen-powered internal combustion engines or to operate a fuel cell. The Examiner argues that the differences between the Boffito et al. process and that of the instant invention is that Boffito et al. do not disclose passing a mixture of ammonia and an oxygen-containing gas to a reaction zone wherein the ammonia undergoes decomposition to nitrogen and hydrogen and wherein a first portion of the hydrogen is combusted in a reaction zone to produce an effective amount of heat to maintain the ammonia decomposition reaction. Rosenblatt et al. is cited for teaching the generation of the hydrogen required for the hydrogen fuel cell or internal combustion engine by passing a mixture of ammonia and an oxygen-containing gas to a reaction zone containing an ammonia decomposition catalyst.

**Applicants' Position**

Applicants maintain that Rosenblatt et al. do not teach, nor do they suggest, that the autothermal reactions to produce nitrogen and hydrogen from ammonia can be conducted in a single reaction zone using only single nickel catalyst. As previously mentioned, Rosenblatt et al. requires two catalysts. One catalyst is a platinum catalyst used for the combustion reaction and the second catalyst is one containing ruthenium, rhodium, or iridium used for the decomposition

reaction. The process of Boffito et al. is not an autothermal process, but merely a process wherein they crack ammonia with a zirconium-containing alloy to generate hydrogen that can be used in a fuel cell.

Applicants again request that the Examiner reconsider and withdraw this rejection.

### **Second Rejection of Claims 12-27 Under 35 U.S.C. 103(a)**

Claims 12-27 are again rejected under 35 U.S.C. 103(a) as being unpatentable over Rosenblatt et al. as applied to claim 1 above and further in view of Boffito et al.

#### **Examiner's Position**

The Examiner believes that it would be prima facie obvious from Boffito et al. to employ the hydrogen produced in the process of Rosenblatt et al. to power an internal combustion engine or to operate a fuel cell.

#### **Applicants' Position**

Applicants again argue that the instant claims, as now amended, are not suggested by Rosenblatt et al. since a single catalytic metal, Ni, is not taught as being used alone for an entire autothermal reaction of ammonia to nitrogen and hydrogen. Since this is not suggested by Rosenblatt et al., then such a process is also not obvious. Therefore, applicants request that the Examiner also reconsider and withdraw this rejection.

### **Rejection under 35 U.S.C. 112, 2nd Paragraph**

Claims 6 and 23 are rejected as being indefinite for failing to particularly point out and distinctly claim the subject matter that applicant regards as the invention. The Examiner points out the improper Markush terminology is used.

Applicants have amended claims 6 and 22 to now include proper Markush terminology. Although the Examiner rejected claim 23 under 35 U.S.C. 112 applicants believe the Examiner meant claim 22. This confusion may have come about since the original claims contained two claims numbered 19, one of which has been canceled. Therefore, applicants request that the Examiner withdraw this rejection.

In view of the above, it is applicants' position that the claims, as now amended, define a patentable invention over the art. Therefore, applicants request that the Examiner pass this application to allowance.

Respectfully submitted,

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